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INVESTMENT FOR PUBLIC WELFARE[1]

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EVERY person makes some sort of financial investment for the benefit of the public. Through taxation he contributes, willy-nilly, to those public services operated by the government. If his income exceeds his necessary expenditures, he frequently makes voluntary gifts. In either case, it is a matter of natural concern to him that his investment be efficiently administered for purposes of unquestioned social value. If his investment is by voluntary gift, as to a charitable institution, he naturally selects the objects of his altruism with care; if it is through the taxation route, he is too often insufficiently alert to the type of judgment and management exercised by his elected agents, the government.

[1] Address at the annual dinner of the Technology Club of New York at the Waldorf-Astoria, New York, on the evening of May 6.

As contrasts of stewardship and wisdom in handling our money for the public welfare I choose two examples of approximately equal size, the Passamaquoddy Power Project and the Massachusetts Institute of Technology. The former illustrates a type of government expenditure uneconomically and politically conceived; the latter typifies the better class of educational institution or altruistic foundation. If you prefer illustrations on a still larger financial scale, take the Florida Ship Canal and Harvard University, or the completed Grand Coulee Dam and the Rockefeller Foundation.

The Passamaquoddy Power Project, if carried through, will realize man's long-cherished dream of harnessing the tides in a large way. Perhaps its appeal to the imagination accounts for the fact that the government has appropriated $7,000,000 and has

spent $6,000,000 for it before ascertaining if the plans were technically sound. In its present "third revised edition" it has been officially estimated to cost $36,250,000. More careful geological study reveals, however, that the plan of a high altitude reservoir, pumped full during the tide power interval and supplying power during the remainder of the daily cycle, involves difficulties. To surmount these or to provide an alternative source of reserve power will cost several times the $9,000,000 set aside for this item in the original estimates, according to expert opinion. There are other features which similarly point to increased cost, so that the actual bill for the completed project will probably not be less than $48,000,000.

What returns, of social value, to justify this expenditure, are expected? The Quoddy project is planned to deliver some 30,000 kilowatts of electric power. Its investment cost will be more than $1,500 per kilowatt, a figure so high that it could not compete in economy with a steam plant, even if its operating and depreciation charges were completely ignored. A steam plant to produce the same power on the same site would cost approximately $100 per kilowatt. It has properly been said that this project "breaks all records in getting the least electricity for the money."

There is no present demand for this power, and nothing but vague suggestions and hopes for its possible future use. The attempts to prove a by-product value are equally vague and unconvincing. Its actual operation could only be at the expense of every taxpayer and the simultaneous destruction of public utility companies which now serve the region adequately and more cheaply.

Your money and mine, in the form of taxes levied ostensibly to promote the public welfare, pays for the Quoddy and other similar projects. Would you, by choice, spend your money to promote public welfare in this manner? Let us present to you a contrast in values.

The Massachusetts Institute of Technology represents an investment of $48,500,000, of which one third is in plant and two thirds are in endowment. It has produced, not 30,000 kilowatts, but 30,000 alumni. It has played a powerful rôle in the scientific and technical developments that have brought to the people of this country a large portion of their employment, safety, health, comfort and convenience in living. More than a thousand of its alumni are teachers, widely extending its educational influence. Nearly 10 per cent. of its students come from 39 foreign countries, forming a strong international link of friendship and commerce.

M. I. T. graduates are heads of research laboratories, executives in industrial, building, transport and power enterprises of foremost rank; heads of important banking and investment institutions; public servants for cities, states and the nation. They permeate the new technological America. Let me quote a few examples.

Technology graduates are presidents of General Electric, General Motors, du Pont, Goodyear, Eastman Kodak, Stone and Webster, United Fruit, Sun Oil, Winchester Arms, Babson's, Central Railroad of New Jersey, Technicolor, American Brake Shoe and Foundry, Douglas Aircraft, Bell Laboratories, Thomas A. Edison, Inc., Phelps Dodge, Campbell Soup, Revere Sugar, Jos. T. Ryerson and Son, Vermont Marble, Niagara Power and a host of other companies. The number of chairmen of boards and vice-presidents is legion. Among the graduates of electrical engineering, just one of the eighteen departments, are 105 corporation presidents, 67 vice-presidents and 27 chief engineers. Of the 23 Associated Factory Mutual Fire Insurance Companies, which have done such splendid work in developing methods of fire prevention, nineteen have Technology men as presidents!

In the field of finance we find M. I. T. men at the heads of such institutions as the First National Banks of Boston, Denver and Portland, Oregon; The Equitable Trust and Guaranty Trust Companies; Hayden, Stone and Company; First Boston Corporation; American International Corporation; Bank of America.

Every vessel now in the United States Navy was designed by former M. I. T. students and built mainly under their supervision. Technology built and operated the first wind tunnel and established the first course in aeronautical engineering in America. Today a "who's who" list in American aviation, whether civilian or military, technical, industrial or even in pioneer flying, is strikingly a Technology register. The same statement can be made with respect to the nation's physical chemists. Among the many prominent architectural graduates are the heads of a dozen schools of architecture.

The modern profession of chemical engineer was created at M. I. T., and its graduates in this field are absorbed by industry like molecules by a vacuum. It was the first technological institution to recognize and provide for the important place of economics in the training of the engineer. In collaboration with Harvard, it established the first systematic training in public health, and its staff performed a major portion of the pioneering work in developing sanitary municipal water and milk supplies, methods of sewage disposal, municipal public health surveys and methods for protection of canned foods on an industrial scale from bacterial action.

Specific examples are more convincing than generalities. I therefore take the cases of two civil engineers who have been continually closely associated

with the institute. Of one, a recently deceased member of M. I. T.'s corporation, it has been written: "The scope of civil engineering has been admirably demonstrated in this country by a distinguished graduate of M. I. T. who was consulted on the Panama Canal and on the Keokuk Dam across the Mississippi; organized a nation-wide fire prevention service for fire insurance companies; was president of six insurance companies; was consultant on water supply construction and investigation in Los Angeles, San Francisco and Baltimore; was engineer for the Chinese Government on the Yellow River Control Project; became an authority on the design of buildings to resist earthquakes, and on engineering geology; and promoted the construction of our National Hydraulic Laboratory."

The other, in addition to engineering research, publications and activities in professional societies, has performed the following services to governmental agencies as consultant: Advice to City of Boston on reorganization of public works activities and engineering services, in interest of efficiency; revision of Harvard Square Station, Boston Elevated Railway, and traffic conditions surrounding it; investigation of defects in Worcester turnpike and other problems for the Massachusetts Department of Public Works; consultant for twelve cities in Massachusetts in highway problems; design for rebuilding the district of Salem, Massachusetts, which was burned in 1919; service to several metropolitan cities and towns on apportionment of cost of the Charles River Basin; investigation of sixty schoolhouses for fire protection; revision of Lynn, Massachusetts, sewerage system; design of Little River improvement for Haverhill, Massachusetts; service on Traffic Commission for Cambridge, Massachusetts; investigated Pickwick Club disaster for City of Boston; consulted on elimination of grade crossings for eighteen cities and for the Vermont Public Utilities Commission, involving $40,000,000 of construction work; advised Metropolitan District Commission on freight terminals; advising Massachusetts Department of Public Works on revision of its engineering organization.

These two men are not unique, they simply illustrate the fine type of service which the public receives as the result of institutions like M. I. T. Some, like these, bring safety and convenience through public works. Others create new industries. Others discover new materials, forces and relationships in nature through science. Still others are performing skilled tasks in a multitude of the activities of our modern era. Altogether, they epitomize the American civilization.

Thus far I have discussed the human product of M. I. T., its staff and alumni. But there is also another type of product, comprising the actual results of research and invention that have come from its laboratories. Here the number and variety is so great that I shall make no attempt to enumerate past achievements, but mention only a few of the more significant of the four hundred odd subjects that are now in process of investigation or development.

A new optical material for lenses has just been developed to the stage of commercial production. It is the most transparent and the freest from chromatic aberration of any known solid substance, and its method of production has further applications.

A new method of producing artificial textile fibers of hitherto unequalled fineness is developed to the stage of examining its various possible applications.

Apparatus for detecting the most deadly of known types of poisoning has been perfected and a method of curing this hitherto incurable affliction has been proven successful, and both will be made available to the medical profession within a few months.

Three types of automatic devices for solving hitherto practically insoluble mathematical equations have reached the stage of demonstrated successful use, though they are still being improved. These open up entire new categories of practical applications of mathematics to statistics, engineering design and scientific problems. They have applications also to the automatic accurate control of machinery.

A new form of high voltage generator for x-ray outfits used in medical therapy, operating on radically new principles and with marked advantages and economy over previous types, has been invented and tested, and the first unit is being installed in the Huntington Memorial Hospital.

An entire new and unexplored field of electrical science and electrical engineering has been opened up by a group of recently developed electrostatic machines that show promise of important industrial uses, and are being actively investigated.

A metallurgical study, completed within the past year, is estimated to save several million dollars in the operations of an important industry through elimination of faulty products.

An improved method of refrigeration, embodying several new features, has provided a far more efficient, economical and convenient apparatus than was formerly known for securing very low temperatures. This was built and demonstrated during the current year, and it opens the way to a new important program of research in physical chemistry.

Probably some millions of dollars throughout the world have been spent in efforts to produce more powerful magnetic fields, because of their importance in engineering and scientific research. A new form of magnet has been designed and tested during the past two years which makes possible constant magnetic fields several times as powerful as any hitherto achieved.

For the army engineers a hydraulic study of the Cape Cod Canal has just been completed. With reproduced tides in Massachusetts and Buzzards Bays driving water through an accurate scale model of the proposed widened and deepened canal, tests were made which determined the most advantageous contours, positions for fills, current velocity and effect on the shallow approaches.

A process has been discovered within recent months which shows promise of considerably reducing the cost of manufacture of one of the industrially important acids.

Two years ago the first successful method of dissipating fog over restricted areas was demonstrated, and its practical use in aviation is being explored with the cooperation of interested governmental agencies.

During the past year, for the first time, a method has been devised and applied for impressing on a shaking table an accurate reproduction of the motions of any actual earthquake. It is being employed to develop a new technique of earthquake-safe building construction.

Five years ago a uniquely equipped spectroscopy laboratory was built. Last year a machine was invented which rapidly and automatically performs the computations of spectrum wave-lengths with hitherto unequalled speed and accuracy. This year a staff of sixty-five WPA clerical workers are assisting in the preparation and publication of a revised classified list of wave-lengths of all the millions of spectrum lines of all the chemical elements, a job which, a few years ago, would have been entirely beyond the reach of any institution. This done, a second automatic instrument invented two years ago will facilitate the rapid accumulation of knowledge of atomic structure from this assembled mass of data.

Several years of study of direct and indirect effects of ultra-violet light in curing rickets have led, among other things, to precise determination of the relative effectiveness of light in different parts of the spectrum.

Automatic devices have been developed to record automatically the relative amounts of listening to different radio broadcasts and also for performing automatically the complicated operations of sales recording and accounting in large stores.

Within the year discovery has been announced of the cause of existence of a large class of minerals which previous theories said ought not to exist. This discovery has valuable geological implications and suggests useful applications in the development of new alloys.

Independently of and simultaneously with the Bell Laboratories, there has just been announced a radically new type of conductor for transmitting electrical communications which has interesting possibilities of application that may be extremely important.

A new type of engine, a new method of hardening steel and protecting it from corrosion, new instruments for detecting faults in structural metal, a new device for reducing vibration in aircraft, a chemical form of sex hormone and determination of geological age of rocks—all these are but a few products and activities of the M. I. T. laboratories at the present time!

Here you have the contrast, on the one side a project of complete economic futility and on the other an institution which, in my judgment, has been of greater aggregate value to the country than any other institution based on a comparable investment. If it be argued that Quoddy is justified as a means of giving employment, I would reply first that the direct and indirect employment produced by M. I. T. far exceeds that provided by Quoddy and is permanent, and second that emergency employment could have been found in far more useful projects than many of those selected.

Now a word about the reason for these remarks is in order. At an alumni gathering, a certain amount of self-glorification of the college is traditional and excusable. Also it is customary to say something about current activities in the institution. Both of these elements appear in what I have said, but my main purpose goes further:

I believe that we have only scratched the surface in our program of promoting the public welfare along the lines of our charter, which directs us to "aid generally by suitable means the advancement, development and practical application of science in connection with arts, agriculture, manufactures and commerce." The world, and particularly our own country, are rapidly entering an era in which scientific management and technical skill will be increasingly important. As our geographical frontiers have been expanded to the limit and our natural resources of soil, timber and minerals have been occupied, further increase in wealth or population or satisfaction in living can only come through wiser uses of our existing resources. That is the great challenge of society to science, and that is exactly the field of M. I. T.'s special mission and opportunity.

My belief in the possibility of an enhanced value of the institute to the public is based on careful study of its potentialities of staff, equipment and organization. The educational program requires a staff which includes experts in almost every aspect of science and engineering. Thus there is available for attack on any problem a closely knit, cooperating group with wider range of technical experience and approach than can be found probably in any other organization in the world. Because of the teaching program, there-

fore, this framework of a research organization is already provided. Reciprocally, a staff which is active and alert in handling the live problems of the technical professions is best able to steer its students, as apprentices, into these professions. There is urged, therefore, a more adequate development of our research program along lines that will increase the value of the direct contributions of our staff and advanced students, and whose stimulating influence will permeate down into the undergraduate years.

Despite the splendid record of past accomplishment and the impressive current program of creative activities, it is a fact that we are not making full use of our opportunities. We are able to develop only a few of the promising ideas which are continually occurring to our staff, and we handle those which we do develop inefficiently through lack of facilities. We are in the situation of possessing a great reservoir of scientific discovery, invention and technical skill, without the relatively minor but essential subsidiary help required to exploit this reservoir. We are an organization, which, because of its educational program, has all the overhead necessary for a great research program but which lacks the funds for operating expenses on a scale efficiently to utilize this overhead.

No educational institution in my knowledge has ever approached its possibilities for contributing to public welfare by giving attention to the efficiency of its research program comparable to that which it gives to its teaching. No institution has such great possibilities in this direction as the Massachusetts Institute of Technology. I can imagine no investment for public welfare so likely to secure large returns as one which would permit the latent creative powers of this institution to become really active.

We have done everything that we know how to do to make our teaching program effective and our administrative organization efficient, but by and large we have let the research activities play a subsidiary rôle, supported by whatever funds were left over. Under the circumstances which have existed, this has been necessary and proper. But the fact remains that we have a great opportunity which has not yet been adequately realized. If we could find a few hundred thousand dollars a year to exploit this opportunity, I am as certain as that I stand here that a new epoch in public service by an educational institution would follow.

Amid the difficulties to educational institutions which arise from various current political trends, it is important that the best privately controlled institutions shall maintain the educational leadership and traditions for the benefit of *all* education, governmentally controlled and private. The criterion for survival of a private institution in these difficult days will be that it offer a quality of education and public service definitely superior to that obtainable in governmentally operated institutions. This is the challenge of the future to those who administer the affairs of private institutions and to those who wish such institutions to endure as vanguards and bulwarks of a free and progressive social order.

PLAIN STATEMENTS ABOUT RACE

By Professor EARNEST A. HOOTON
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INTRODUCTION

MAN is a predatory mammal which has achieved dominance over all vertebrates by a ruthless use of superior intelligence. From prehistoric times this ingeniously selfish biped has realized that the greatest gain of power and booty lies in preying upon his own species. It is easier to seize wealth than to create it. Yet a certain quality of benevolence has been at variance with simple brute predaciousness throughout the long struggle for survival and domination which is the history of this super-ape. Thus, man has evolved certain ideals of humanitarian behavior which often manifest themselves in disinterested and self-sacrificing acts on the part of individuals and even of social groups. This apparently innate generosity may or may not be some sort of social extension of a maternal instinct. Through centuries of painstaking cultivation and encouragement it has been built up to a point where it has sometimes seemed to bid fair to dominate human behavior and thus to inaugurate the millennium. Unfortunately, human altruism seems to distintegrate in political and economic stress, except as an individual phenomenon. It is not a common characteristic of the large political and social groups which we call nations.

Man incessantly seeks to compromise with his conscience or with his innate humanitarianism by rationalizing his predatory behavior. He must convince himself that the act of grabbing is somehow noble and beautiful, that he can rape in righteousness and murder in magnanimity. He insists upon playing the game, not only with an ace up his sleeve, but with the smug conviction that God has put it there.

We need not speculate upon the arguments with which primitive man presumably convinced himself that he was glorifying God by getting dominion over "the fish of the sea, and the fowl of the air, and over